different portions of the Diatom-valve under the action of fluoric acid—assuming, as every portion is of precisely similar density, that the thinner parts must be the first to succumb to the eroding action. I may mention that the acid was very gradually applied in fumes to the Diatoms previously dried and fixed on slips of mica.

In the stouter and more coarsely marked *Naviculæ*, in which the median line is surrounded by a broad unstriated area of silex, from the outer margin of which the striation commences, the striated portion was invariably destroyed first, the dotted points being the foremost to yield. The median line and its adjoining area yielded last.

In *Cocconeis distans* the dots at once yielded, and then increased in size until the intervening portions of silex were altogether eroded.

In *Biddulphia, Triceratium*, and *Isthmia*, the interspaces yielded first. The costæ of *B. pulchella* and *B. regina* yielded last.

In *Pleurosigma formosum* and *P. balticum* the action on the entire structure was so instantaneous and complete that it was difficult to apply the smallest quantity of the fumes without altogether consuming the valves. But wherever portions remained, the outline was identical with that shown when the valves are fractured, thus clearly confirming the view that the portions constituting the linear markings are the thinnest. In these forms the median and terminal nodules were the last to succumb.

Lastly, it is worthy of notice that in those portions of the Diatom-valve which present a delicate pinkish tint the siliceous structure is the thickest. Where the tint is grey or inclining to green, the film may be regarded as being of extreme tenuity. The same feature holds good amongst the Polycystina, and is indeed more strikingly observable in that family, owing to their superior size and solidity.

XLI.—*Further Observations on an undescribed indigenous* Amœba, *with Notices on remarkable forms of* Actinophrys *and* Difflugia. By G. C. Wallich, M.D., F.L.S., F.G.S., &c.

[Plate IX.]

The very singular characters presented by the new form of *Amœba*, to which attention was drawn by me in the last Number of 'The Annals,' having induced me to keep it under constant supervision during the bygone month, I am glad to be enabled to confirm the description there given, and at the same time to add several new facts regarding it and two other species of indigenous Rhizopods, which can hardly fail to excite interest. I beg to state, however, that the present and former communication on this subject must only be regarded as of a preliminary nature, and published with a view to afford naturalists an opportunity of personally investigating the organisms in question. When it is borne in mind that we are now treating of creatures holding the lowest position in the scale of being, and that it has been customary to assign to them a degree of simplicity of structure wholly incompatible, so far as all analogy teaches, with the vital functions they are known to perform, it will, I think, be allowed that this unlooked-for phase in the history of the Rhizopods cannot be too minutely scrutinized.

From a further supply of the material containing the *Amœbæ* obtained towards the close of March, it would appear that the form is tolerably plentiful—occurring, however, only in those shallow pools, highly impregnated with ferruginous matter, that are to be met with in certain parts of Hampstead Heath. In the clear pools not a single specimen, having the novel characters I have described, is to be found.

Out of the numerous individuals examined by me, I should say that not more than 5 per cent. have been deficient in the villous patch; and from the mode in which some of the larger specimens have been rent asunder by pressure whilst under observation, so as to form two distinct beings, there seems every reason to believe that these apparently exceptional specimens have been produced by similar means. Under the circumstances, I think the *Amœba* may safely be regarded as a well-marked species, and I accordingly propose that it should be named *A. villosa*.

I mentioned in my former notice that the contractile vesicle and nucleus were generally to be seen in the vicinity of the villous patch, and that, in a single example, the latter had assumed the shape of a spherical tuft attached to the body by a cylindrical pedicle of sarcode. During the past month I have had ample opportunity of verifying the observation that, in the majority of specimens, so long as the villous patch is not being employed as an organ of prehension, but is merely dragged along in rear of the main body, the nucleus and contractile vesicle retain their position in its vicinity, but that they circulate with the other contained matters whenever the prehensile action of the villi is not in abeyance. Several specimens have exhibited the tuft and pedicle, but not in so symmetrical a form as the first one observed by me. These are very material points, inasmuch as they tend to prove that some kind of consentaneous action takes place between the contractile vesicle, the nucleus, and the villous area, even independently of the appearances now about to be described.

In several specimens, a delicate funnel-shaped tubule was visible passing longitudinally through the villous tuft (Plate IX. fig. 3). When this occurred, the contractile vesicle was not to be seen. Minute particles of effete matter, accompanied at times by shreds of sarcode, were frequently extruded at the infundibuliform orifice,—their passage outwards being slow till the orifice was reached, when they seemed to be forced out with a jerk. On three occasions, what appeared to be a minute vacuole (for it did not pulsate) was similarly extruded, its sarcodic investment assuming the shape of a minute villous tuft, which remained adherent for a time to the main body by a slender filament, but became eventually detached when the creature had advanced to a sufficient distance to overcome its extensile powers (Plate IX. fig. 4).

It is a very curious fact that in one of the saucers into which the material containing the *Amœbæ* was placed, and in which the water had been purposely allowed to evaporate to a considerable extent, the whole of the specimens seemed to undergo another change. This consisted in the formation of a large subspherical or ovate mass of homogeneous granular matter, which occupied the entire posterior* fourth of the body, causing it to bulge, with more or less regularity, around the base of the villous tuft, and, like the latter, never quitting that position (figs. 1, 2, & 3).

In this phase of the *Amœba* the normal erratic pseudopodia were hardly ever projected, but the body maintained an elongated cylindrical shape, with comparatively rapid flowing movements, during the occurrence of which the villous tuft was passively dragged along. This granular mass at first sight resembled a much enlarged nucleus without its containing vesicle. Although its boundaries were well defined posteriorly, the granules seemed to amalgamate to some extent with the general endosarc anteriorly, and at times a portion of the granules left the mass and took part in the general cyclosis. But in some individuals the true nucleus could be seen distinctly within the boundary line of the granular mass, although it was impossible to determine whether it was actually imbedded in its centre, or occupied a position externally to it but within the ectosarc. In these specimens the contractile vesicle was not observed to undergo its normal diastolic and systolic action; and hence it is possible that the vesicles seen may in reality have been vacuoles, in this condition of the organism. At all events, further information is requisite before the point can be accurately ascertained.

It is highly probable, however, that the granular mass referred

* Reptation is so manifest in these *Amœbæ*, and the direction of their movements is so uniformly opposite to that in which the villous area is situated, that I have deemed it legitimate to employ the terms *anterior* and *posterior* in my description of the parts.

to is of the nature of a nucleus. In appreciable characters, both as to colour, form, and size, the component granules are identical with those seen in the true nucleus. But the analogy is well nigh confirmed from the circumstance that, at a still later period, when evaporation of the water had gone on to a greater extent, the entire granular mass referred to became segregated, as if by a process of segmentation, into numerous distinct nuclei, amongst which the true nucleus was not recognizable as a separate or different structure. These multiple nuclei, varying in number from five to about a dozen, were contained in no separate cavity or cavities, but occupied the position previously occupied by the single large granular mass. In the specimens exhibiting this structure, the animal seemed inclined to assume an encysted form, motion being almost totally suspended, and the short conical pseudopodia projected from all parts of the surface except the villous area, being withdrawn and re-extended with extreme slowness, and only at long intervals (Plate IX. fig. 5). After a time (whether from the pressure of the glass cover or otherwise, I am as yet unable to determine), these multiple nuclei were extruded, one by one, in the vicinity of the villous area. During extrusion, and for several minutes subsequently, they retained their spherical mulberry-like form. They then, one after the other, fell asunder as it were,—the granular disruption seeming to commence at a single central point, and afterwards to extend equally on all sides. The granules, when released, formed a delicate cloud, each granule maintaining a tremulous and apparently molecular movement for a few seconds, and ultimately assuming a condition of perfect rest. At fig. 5*a* I have shown one of these nuclear masses as seen when first extruded.

In a single example, occurring in the material originally procured, a very distinct membranous capsule was observable (fig. 6). This had all the appearance of being true ectosarc, inasmuch as it not only closely invested the body, but the boundaries of the villous area. I have already stated in my previous paper that acid and alkaline reagents failed to render evident any such membrane as is alluded to by Auerbach and Schneider. Repeated attempts with these reagents have since been made by me to bring the membrane into view, but without success. In the single specimen now under notice, all movement of the body had entirely ceased, and it appeared to be strictly encysted. But there still remained a slow cyclosis of the granular particles; so that life was not extinct. It is just possible, therefore, that the membranous capsule may not have constituted an integral portion of the *Amœba* in question, but that the latter may have accidentally insinuated itself into the effete cell of some other animal. It is a significant fact, however, that the membrane resisted pressure in a manner that showed its strength and at the same time the probable absence of any aperture through which its contents, if not forming part and parcel of itself, might have escaped. In short, disruption did not take place until after the glass cover in use (measuring ·008 of an inch in thickness) had been broken. The wall then exhibited very distinct angular folds and a clear membranous outline, but of too great tenuity to admit of the measurement of its thickness. In this specimen the nucleus, probably owing to displacement by the pressure, occupied a position at the centre of the body—no contractile vesicle or larger granular mass being present, but several vacuoles being scattered through its substance.

One of the most remarkable amongst the novel and varied characters of these *Amœbæ* consists in the vesicle in which the true nucleus is contained having been found to be distinctly membranous in some individuals. In the figures appended to my paper in the last Number of the 'Annals,' I endeavoured to show the definite appearance of the vesicular chamber of the nucleus; but at that time I had no idea of the peculiarity thereby indicated, nor did I become aware of it, or indeed believe in it, until I had seen several nuclei *with their vesicular covering* completely isolated from the main body by means of the compressor. The fact, startling as it seems, is nevertheless certain, that in these specimens the nucleus was contained in a distinct membranous cell of its own, and that this cell admits of perfect isolation without undergoing rupture. The cell-wall was spherical in its extruded state, perfectly hyaline, tough, and resisting, and forming irregular folds under augmented pressure, as shown in figures 7 and 7*b*,—a clear nucleolus, as before described, being visible in the interior of the granular nucleus, and the space between the nucleus and cell-wall being occupied by a still more attenuated *granular* protoplasm. In contradistinction to this, the multiple nuclei, already spoken of, had neither investing membrane nor nucleolus. Can it be that the one phase represents the germ-cell, and the other the sperm-cells?

Another fact is deducible from the appearances presented by the sarcode-substance of the largest of these *Amœbæ*. The rush of granules does not follow upon a previous contractile effort exercised at the posterior portion. As the animal progresses, occasionally altering its course, there are periods during which perfect quiescence is maintained by the granules; and the rush or flow of these seems to take place, as it were, to fill up the vacuum engendered by the sudden projection of a portion of the ectosarc in the shape of a pseudopodium. Hence it would appear that motion is dependent on the contractile power of the external sarcode-layer, and that the endosarc only passively participates in it. If this view is correct, it involves a very important consideration; for it proves that the old German doctrine of a "primary contractile mucus" is essentially correct, and that the circulation is not dependent, even in part, on the alternate expansion and collapse of the contractile vesicle. Further than this, it affords the strongest confirmation of the high degree of differentiation existing between the endosarc and ectosarc of the Amœban group.

The mysterious faculty resident in the latter portion of the structure, of forming extempore orifices for the inception or extrusion of food-particles, &c., may be witnessed in these specimens in a very singular manner, and one which, as far as I am aware, has not hitherto attracted attention. I allude to the projection of the ectosarc from some area of the general surface in the form of a hemispherical mass with a broad base, only a very small portion of the original contour line seeming to give way at first, so as to admit of the passage of the endosarc and other granular contents into the newly projected part, but its entire floor appearing to be gradually dissolved, as it were, and free communication between the main body and the new pseudopodial cavity not being established until the completion of this process. Whilst it is progressing, the endosarc-granules seem to rush round a corner into the cavity, the corner gradually receding, so to speak, and ultimately being altogether obliterated.

From these facts it is obvious that the ectosarc and endosarc *are not permanent portions of the Protean structure, but mutually convertible one into the other; and that it is an essential feature of sarcode that, whilst the outer layer for the time being becomes,* ipso facto, *instantaneously differentiated into ectosarc, the same layer reverts to the condition of endosarc under the circumstances just described.* In the latter part of the process, that is, the reversion to the condition of endosarc, the action is by no means so instantaneous as when the converse takes place. In the Actinophryans both processes are, comparatively speaking, slow.

Lastly, I have to state that when the homogeneous sarcode is poured forth from these *Amœbæ* under pressure, the globules show no tendency whatever to coalesce. In general, the masses of sarcode are expelled in irregular-oblong or ovate portions of varying sizes, which rapidly detach themselves, and then at once assume a perfect spherical form. It is very rarely indeed that foreign bodies remain within these masses, or are extruded as part of their contents. They are extruded separately under these circumstances. The sarcode constituting the sphe-ules, when first it escapes, appears perfectly homogeneous, and s granules are extremely minute. After the lapse of a period arying from a quarter tohalf an hour, this homogeneous character disappears, and a species of segmentation takes place, the minute granules becoming more closely aggregated together, so as to form irregular and somewhat darker patches within the spherule, whilst the form of the latter is in nowise modified. A representation of these phenomena is given on a largely magnified scale in figs. 8, 8*a*, and 8*b*.

[To be continued.]

EXPLANATION OF PLATE IX.

Fig. 1. *Amœba villosa*, showing the position and appearance of the large granular mass, with the true nucleus, and cylindrical form assumed by the *Amœbæ*.

Fig. 2. A specimen in which the contractile vesicle is apparently replaced by a conical-shaped vacuole.

Fig. 3. The granular mass and villous tuft, showing the infundibuliform tubule.

Fig. 4. The villous tuft and infundibuliform tubule, with an extruded vacuole (?), and its investiture and sustaining filament of sarcode.

Fig. 5. An *Amœba* with multiple nuclear bodies.

Fig. 5*a*. One of these mulberry-shaped nuclei, as seen immediately after extrusion.

Fig. 6. Encysted ? form, with distinct membranous envelope.

Fig. 7. One of the true nuclei after isolation from the parent body, showing its membranous investiture.

Fig. 7*b*. The same, as seen after augmented pressure.

Fig. 8. Largely magnified portion of an active *Amœba*, showing the appearance of the sarcode-globules (8*a*, 8*b*) isolated by pressure.

N.B. The whole of the specimens were more or less full of minute *Crumenulæ*, with which the material in which they were found abounded.

BIBLIOGRAPHICAL NOTICE.

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This valuable memoir comprises information collected on three occasions :—1st. An account of the geological observations made by Dr. Hayden when associated with Lieut. Warren's Expedition, in the summer and autumn of 1857, from Bellevue on the Missouri (about 41° lat., 96° long.) to the mouth of the Big Sioux and back, and then across Nebraska to Fort Laramie, then northward across the Black Hills to Bear Peak (about 44° 30′ lat., 105° 20′ long.), and then south-eastward through the Bad Lands to the Niobara River, and along it to Fort Randall on the Missouri. 2ndly. Geological explorations, by Dr. Hayden and Mr. F. B. Meek, in the north-eastern portion of Kansas territory (between 95° and 98° long., and 38° and 39° 30′ lat.), in 1858. 3rdly. Some results of an expedition to the north-west under Capt. W. F. Raynolds, in 1859–60.